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Guide to the 58th Annual Field Conference of the Section of Geology

April 24, 1983

GEOLOGY FIELD TRIP. The annual Ohio Academy of Science geology field trip will visit the cuesta of the Devonian Columbus Limestone north of Bellevue, with stops to observe the bedrock, associated karst features (sinkholes and free Blue Hole), and related glaciolacustrine beach ridges and sand dunes, as well as to consider Bellevue's groundwater problems. Leaders will be Jane L. Forsyth and Charles F. Kahle, both of Bowling Green State University

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CRUISING THE COLUMBUS CUESTA

OAS Field Guide

April 24, 1963

leaders:

Jane L. Forsyth
and
Charles F. Kahle

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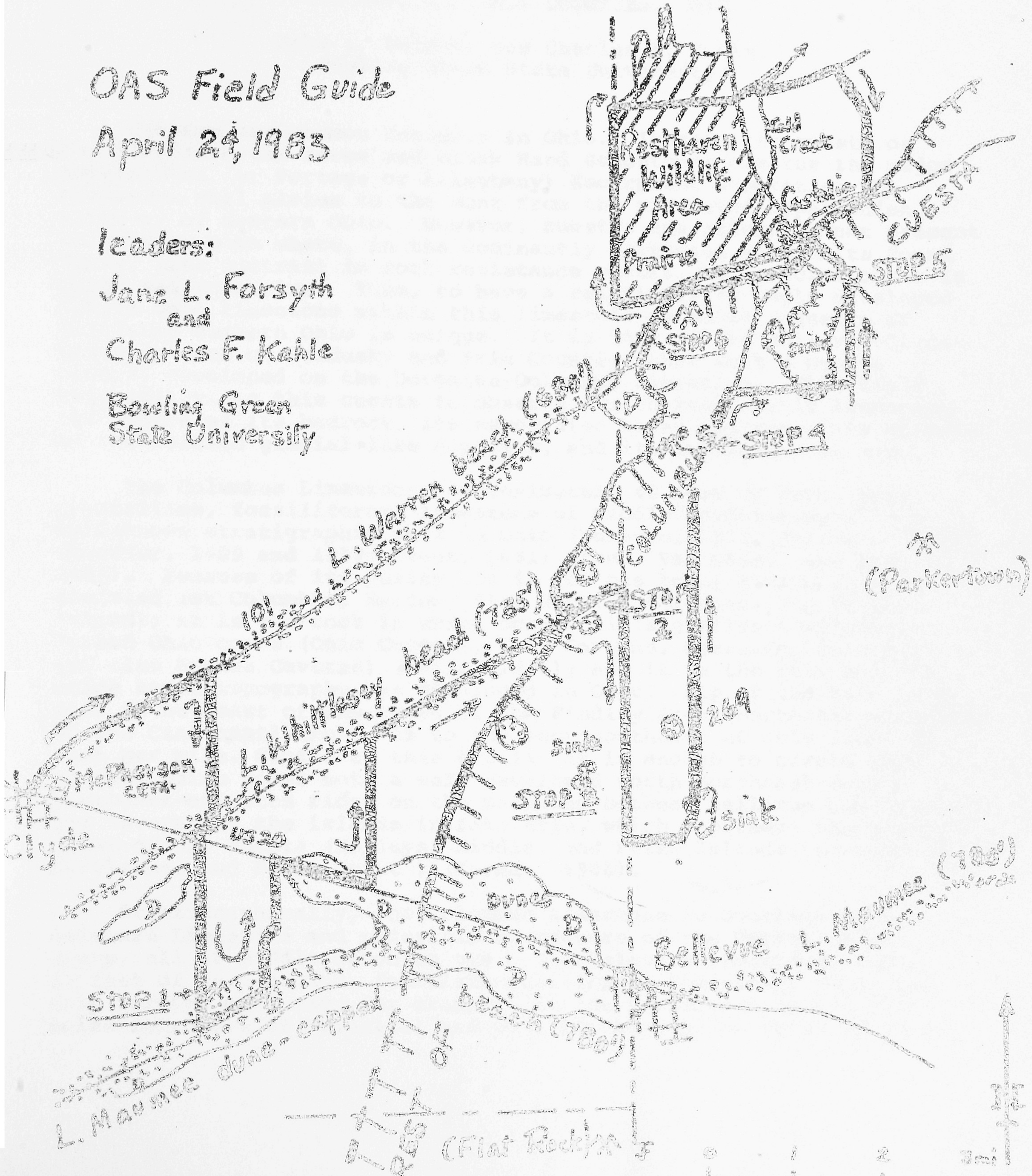
State University



CRUISING THE COLUMBUS CUESTA

A SURVEY OF THE TOPOGRAPHY AND RELATED GEOLOGY ALONG THE DEVONIAN COLUMBUS LIMESTONE CUESTA IN THE BELLEVUE-CLYDE-CASTALIA AREA, SANDUSKY AND ERIE COUNTIES, OHIO

Jane L. Forsyth and Charles F. Kahle
Bowling Green State University

Cuestas are common features in Ohio. Indeed, the cuesta on the Mississippian Berea and Black Hand Sandstones creates the major Appalachian (or Portage or Allegheny) Escarpment separating the extensive till plains to the west from the glaciated Appalachian plateaus of eastern Ohio. However, cuestas are generally not present in western Ohio where, in the dominantly carbonate rock units found there, less contrast in rock resistance occurs, and glacial cover is thick and extensive. Thus, to have a relatively strongly developed cuesta on a limestone within this limestone-dolomite sequence of glaciated western Ohio is unique. It is only in the Bellevue-Clyde-Castalia area of Sandusky and Erie Counties that such a cuesta occurs, developed on the Devonian Columbus Limestone. This field trip will visit this cuesta to observe its characteristic landscape, the nature of its bedrock, its associated karst features, its effects on the related glacial-lake deposits, and its influences on man.

The Columbus Limestone, approximately 40 feet of pure, gray, crystalline, fossiliferous limestone of Middle Devonian age, is a well-known stratigraphic unit in Ohio (Forsyth, 1971; Janssens, 1970; Stauffer, 1909 and 1957; Stout, 1941; Stout, Ver Steeg, and Lamb, 1943). Because of its purity, it is (or has been) extensively quarried (at Columbus, Marion, Flat Rock, Marblehead, and Kelleys Island); it is the rock in which occurs all significant solution-formed Ohio caves (Ohio Caverns, Zane Caverns, Olentangy Caverns; and also Seneca Caverns) (White, 1926); and it is the main unit in which karst topography has developed in Ohio. Dip of the rock here, near to but east of the crest of the Findlay Arch (northeast extension of the Cincinnati Arch), is to the east-southeast at only about 20 feet per mile. Gentle as this dip is, it is enough to create this cuesta, which forms both a well-developed north-northeast-south-southwest-oriented ridge on the mainland between Bellevue and Castalia, and several of the islands in Lake Erie, which represent the emerged crest of the cuesta (Kelleys, Middle, and Pelee Islands, as well as Marblehead and Pelee Point) (Carman, 1946).

Stratigraphically, the Columbus Limestone is overlain by the Delaware Limestone and underlain by members of the Detroit River Group, all of Middle Devonian age. The Delaware Limestone, about 35 feet of thin-bedded, fossiliferous, impure limestone, crops out only farther east (as, for example, in the Parkertown Quarry, four miles southeast of Castalia) and will not be seen on this field trip.

STRATIGRAPHIC SECTION
FOR THE BELLEVUE-CLYDE-CASTALIA AREA, SANDUSKY AND ERIE COUNTIES

	Unit		Thickness	Characteristics
MIDDLE DEVONIAN	Delaware Limestone		35±	thin-bedded, fossiliferous, impure limestone
	Columbus Limestone		40±	pure, gray, crystalline, fossiliferous limestone
	Detroit River Group	Lucas Dolomite	30-40±	hard, gray to brown (locally mottled) dolomite
		Amherstburg Dolomite	50±	hard, drab or brown, finely crystalline, fossiliferous (especially corals) dolomite

Drawn from Carman, 1927; Forsyth, 1971; Janssens, 1970; Sparling, 1971; and Stout 1941.

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The Detroit River Group is represented by two members, both of which are exposed in the quarry to be visited on this field trip. The upper of these two members is the Lucas Dolomite, 12-30 feet of hard, gray to brown (locally mottled) dolomite, underlain by the Amherstburg Dolomite, about 50 feet of hard, drab or brown, finely crystalline, fossiliferous (especially corals) dolomite (the Sylvania Sandstone, the basal sandstone of the Detroit River Group west of the crest of the Findlay Arch, is missing here, east of the Arch) (Carman, 1927; Stout, 1941; Janssens, 1970; Sparling, 1971; Forsyth, 1971). The last stop of the trip is in the Wagner quarry west of Castalia, where the Columbus Limestone, Lucas Dolomite, and Amherstburg Dolomite are all exposed.

Why this cuesta is exposed as a topographic feature is a matter of conjecture, but it is probably a result of the extensive subaerial erosion that preceded glaciation. Before the advent of the Pleistocene glaciers, when there was no Lake Erie, there was a major river here, the Erigan River (Spencer, 1894), which is believed to have flowed generally northeastward, and whose valley subsequently channeled the flow of the advancing glaciers, becoming enlarged and somewhat deepened by the erosion of these glaciers, thus creating the lake basin of today. It is the differential erosion by this preglacial river and its tributaries that is believed to have created the cuestas of the Erie Islands (Carman, 1946), and that probably also formed this cuesta on the land, a cuesta that stood so high that glacial deposits never buried it.

Though glacial erosion created the Lake Erie basin, there is no evidence of significant glacial erosion south of the lake shore, probably because the glacier was too thin there. The only impressive evidence of glacial erosion on land is the famous area of glacial grooves on the northern side of Kelleys Island, at the place where the thicker ice in the Lake Erie basin would have first pushed up onto the edge of higher land next to the lake basin. Farther from the lake, in the area of the Columbus cuesta between Bellevue and Castalia, on the other hand, the only evidence of glacial erosion is shallow striations on any exposed bedrock surface (Goldthwait, et al., 1961).

This cuesta ridge formed a major promontory projecting into the ice-dammed lakes that occurred in the Lake Erie basin during the retreat of the Wisconsin glacier. Each of the three major beaches bends northeastward as it approaches the west face of the cuesta escarpment, and then swings back to the south, east of this feature. These three main beaches are those of Glacial Lake Maumee at 780' elevation, of Glacial Lake Whittlesey at 735', and of Glacial Lake Warren at about 680'. There were actually about a dozen different levels of Lake Erie during the complex history of Wisconsin deglaciation, levels that are listed in the accompanying table, but most of these levels are represented only by very local, obscure deposits, none of which are evident in this area, so reference is made only to the three major beaches here.

Wherever late-glacial beaches are oriented northeast-southwest in Ohio, as they are here, they show stronger development, perhaps because of the influence of the prevailing westerly winds on that ancient lake. Here, between Clyde and the crest of the cuesta between Bellevue and Castalia, each of these three major beaches is very well developed, with the beach material coarsening as the beach approaches the cuesta (from sand to sandy gravel, locally to cobbles like those along rocky shores of Lake Erie today, in places changing from a depositional to an erosional shore on the cuesta itself). Southeast from each of these major beaches on this western side of the cuesta are sand dunes, the bigger and more extensive dunes correlating with the higher beaches. The route will follow a section of each of the beaches between Clyde and the cuesta crest, as well as passing through some of the dune fields, with a stop on some Maumee dunes, and then follow the Whittlesey beach as it meets the cuesta, stopping first at that junction and then in a Maumee cobble bar.

The combination of the broad, rounded cuesta ridge, the pure, easily dissolved Columbus Limestone composing this ridge, and the moderately wet climate here has led to the formation of many karst features. Sinkholes in the area number over 200, though most are small, and only a few reveal exposed bedrock or an open swallowhole within them (Tintera, 1980). One stop will be made to see some smaller sinkholes in which both the rock and solution-widened joints (swallowholes) are visible, and another stop will be made in the largest sinkhole in the region.

The underground routes by which water moves that has drained down through such sinkholes are probably many and complex, but most groundwater seems to drain northward to springs, or "blue holes", in the Castalia area (Tintera, 1980). The groundwater seems to be able to dissolve passages through the Columbus Limestone readily, but such solution is slower in the underlying Lucas Dolomite, so these springs characteristically form at this contact. There are many springs in the Castalia area, but the three largest are the most famous. Best known is the commercial "Blue Hole", a privately managed spring, whose cool waters also support the Castalia Trout Club, one of several private trout clubs in the Castalia area. Groundwater emerging from the ground is always at the same temperature, the area's average annual temperature, because groundwater is protected from summer's heat and winter's freezing storms. As a result, the water is always cooler than normal surface water in summer (the critical growing season for trout and other organisms) and warmer in winter, never freezing.

Biggest of the three large springs is the large pond in the town of Castalia, locally called "duck pond" because of the abundance of ducks that stay there, partly because the pond never freezes in winter and partly because machine dispensers of cracked corn encourage feeding of the ducks there. The third of the three large springs is the Miller Blue Hole, which is slightly smaller than the other two, is located about 6 miles west of Castalia, and belongs to the State of Ohio. Lunch will be eaten on the shores of the biggest (free) blue hole ("duck pond") in the center of Castalia.

Not all the groundwater moving through joints in the limestone goes north to Castalia, though most does. In his thesis study, Tintera (1980) discovered that, though orientations of observable solution-widened joints in most of the area were toward the north-east (N50-60°E), orientations of solution-widened joints along the higher, western margin of the cuesta were mostly toward the northwest (N40-50°W), suggesting diversion of groundwater in that direction near the escarpment slope.

Water that emerges in the "blue hole" springs is highly charged with lime dissolved from the limestone through which it has moved. Much lime has been precipitated out from these spring waters in the past, particularly in the area of the present state-owned Resthaven Wildlife Area, which lies just northwest of Castalia. In early pioneer times, this was part of an extensive wet prairie "of not less than 200,000 acres, reaching from the present town of Sandusky to Port Clinton before the 1800's", with a wet marl meadow with lime deposits 6-7 feet deep where Resthaven is now located (Monroe, 1974, p. 3).

The marl was mined by Castalia Portland and Medusa Portland Cement Companies from about 1900 until the early 1940's, when the state purchased the wet mined-out land for a game refuge, but heavy public use has degraded the area as a refuge, so it is now being maintained by the state as a wildlife area. Mining did not destroy all the land. A 40-acre remnant of the original prairie, with prairie plants growing on it, occurs in the southwest corner of the Wildlife Area. Some of these characteristic prairie plants, occurring in abundance in the past and still present in this prairie remnant are big bluestem grass, little bluestem grass, Indian grass, reed grass, prairie dock, prairie coneflower, Riddell's goldenrod, and blazing star (Hurst, 1971; Monroe, 1974). These plants are late-bloomers, with the flowers generally nor appearing until August, but we will drive by this ancient prairie and through the Resthaven Wildlife Area after lunch to see where the spring-deposited marl accumulated and was later partly mined away.

The complex of groundwater routes through the Columbus Limestone in the past led the people of Bellevue to make unwise use of this natural plumbing system. People settling in this area in the late 1800's began to make use of the caverned limestone under their homes for sewage disposal, having one well for water supply and a second well for disposal of sewage (Walker, et al., 1961). Each new home-owner repeated this unsafe practice. As time went on, drilling of new wells in this area became "chancy" -- when drilling brought up impure water (containing ugly "stuff"), the well was quickly sealed off and a new well was drilled. The situation became so bad that, at times of intense rainfall, when water levels in the limestone overflowed on the surface, it was not only water that flooded the streets of Bellevue! After long usage, such wells would become so plugged with sewage that it would be necessary to redrill the well to open the "sewage plug" (Walker, et al., 1961). The city of Bellevue itself had both water wells and waste-disposal wells until 1944-46, when contamination levels forced abandonment of these wells and development of surface reservoirs (Walker, et al., 1961).

This disgraceful disposal system eventually led the Ohio Water Commission to request a scientific study of the groundwater-contamination problem there, a study made in 1960-61. This report (Walker, et al., 1961) emphasized the seriousness of the pollution problem, but the city of Bellevue was reluctant to acknowledge the existence of any such problem, because of the excessive costs involved, not only for the sewage plant itself but for the blasting necessary to install sewer pipes in that shallow-limestone, cuesta-crest location, and for the need of every home owner (more than 1400) to completely change the plumbing in his house.

With financial help provided by the government, the need was finally acknowledged and a sewage-treatment plant was built, which went on line in 1970. This plant uses the contact-stabilization process, which combines primary settling and secondary activated sludge as the first process, followed by clarification (secondary settling) and then chlorination, with a final passage through "polishing lagoons" before outfall into local ditches draining into Lake Erie. With this combined treatment, they acknowledge a high-solids problem, but at least raw sewage is no longer going into the groundwater system. Unfortunately, however, in limestone, such polluted water does not readily become purified, so Bellevue sewage is still encountered in drilling and will be a problem for many years to come.

ROAD LOG

between-stop mileage	total mileage	
0.0	0.0	Assemble in McPherson Cemetary in Clyde (intersection of routes US 20 and Ohio 101), lining up along cemetary drive parallel to US 20, facing west. Carpooling is encouraged, but cars may not be left in cemetary (free city parking is available half a mile southwest of intersection). Entire field trip (of about 40 miles) lies on the old 15-minute Bellevue quadrangle, represented by the 7½-minute quadrangles of Clyde, Bellevue, and Castalia. Route 101, the road by which the group will leave McPherson Cemetary, lies on, and to the northeast follows, the glacial Lake Warren beach ridge at 680'. This beach is oriented northeast-southwest here because of its location approaching the west (escarpment) side of the cuesta on the Devonian Columbus Limestone. The beach is especially well developed here, a generalization that has been observed for all glacial beaches with this orientation, perhaps because of the effect of the prevailing westerly winds. Route this morning will follow parts of all three main glacial lake beaches, Warren at 680', Whittlesey at 735', and Maumee at 780'. Drive W out of cemetary and turn R (NE) onto Ohio route 101, following beach of Glacial Lake Warren. Beach crest at first lies off to right, but road climbs up onto it and follows it. Where road lies on beach, low swale, in places connected to natural drains cutting through beach, is present to the south (away from the lake). Did lake water flood this area, making this beach an offshore bar here? Note interesting "gnome rock" (large differentially weathered, crystalline erratic) in yard on left in 1 mile.
2.2	2.2	Turn R (S) off route 101 onto county road 268 (Vickery Rd). Route rises up first across Warren beach and then crosses gently sloping bottom of glacial Lake Whittlesey, composed of till with

between-stop mileage	total mileage	
		occasional thin surface smears of Warren-age wind-blown sand; Lake Whittlesey beach visible in distance ahead.
1.7	3.9	Turn R (SW) off co. rd. 268 onto co. rd. 175, cross busy US 20 with care, and turn L (S) off co. rd. 175 onto narrow co. rd. 264.
		Co. rd. 175 lies on beach of Glacial Lake Whittlesey at 735', though beach and much of ancient shore south of beach (especially off to right-west) are capped by Whittlesey-age dunes. Like the Warren beach, this beach is also oriented NE-SW because of the influence of the Columbus cuesta to the east.
1.3	5.2	Low ridge with house on L (E) is beach called Maumee II, at 760', which is commonly interpreted to identify a separate lake level, subsequently flooded when readvance of the ice caused lake level to rise up to 780' (Maumee III) (Leverett, 1902; Forsyth, 1959; Dorr and Eschman, 1970), though some suggest that Maumee II is just a submerged offshore bar formed contemporaneously with Maumee III (Bleuer and Moore, 1972), a theory contradicted by glacial field studies in lake-outlet areas in Michigan (Eschman, 1978 (see p. 50-51); Burgis and Eschman, 1980). Maumee III beach is visible half a mile ahead (S).
0.7	5.9	STOP 1. Crest of mined Maumee III beach dune. (3½ mi. SE Clyde; C of sec. 29, T4N, R17E; York twp., Sandusky Co.) The Maumee III beach here is oriented NE-SW, but this highest of the glacial beaches shows less influence on its orientation by the Columbus cuesta than do the two lower beaches seen.
		Continue on ahead (S).
0.1	6.0	Turn left (E) by church off co. rd. 264 and onto co. rd. 183 for 0.2 mile and then diagonally left (NE) onto co. rd. 177.
		Co. rd. 177 generally follows the Maumee III beach ridge here. Note the Maumee dunes to L (N), some up to 60' higher than the beach itself.

TABLE LISTING
MAJOR LATE-GLACIAL LAKE LEVELS
IN THE LAKE ERIE BASIN OF OHIO

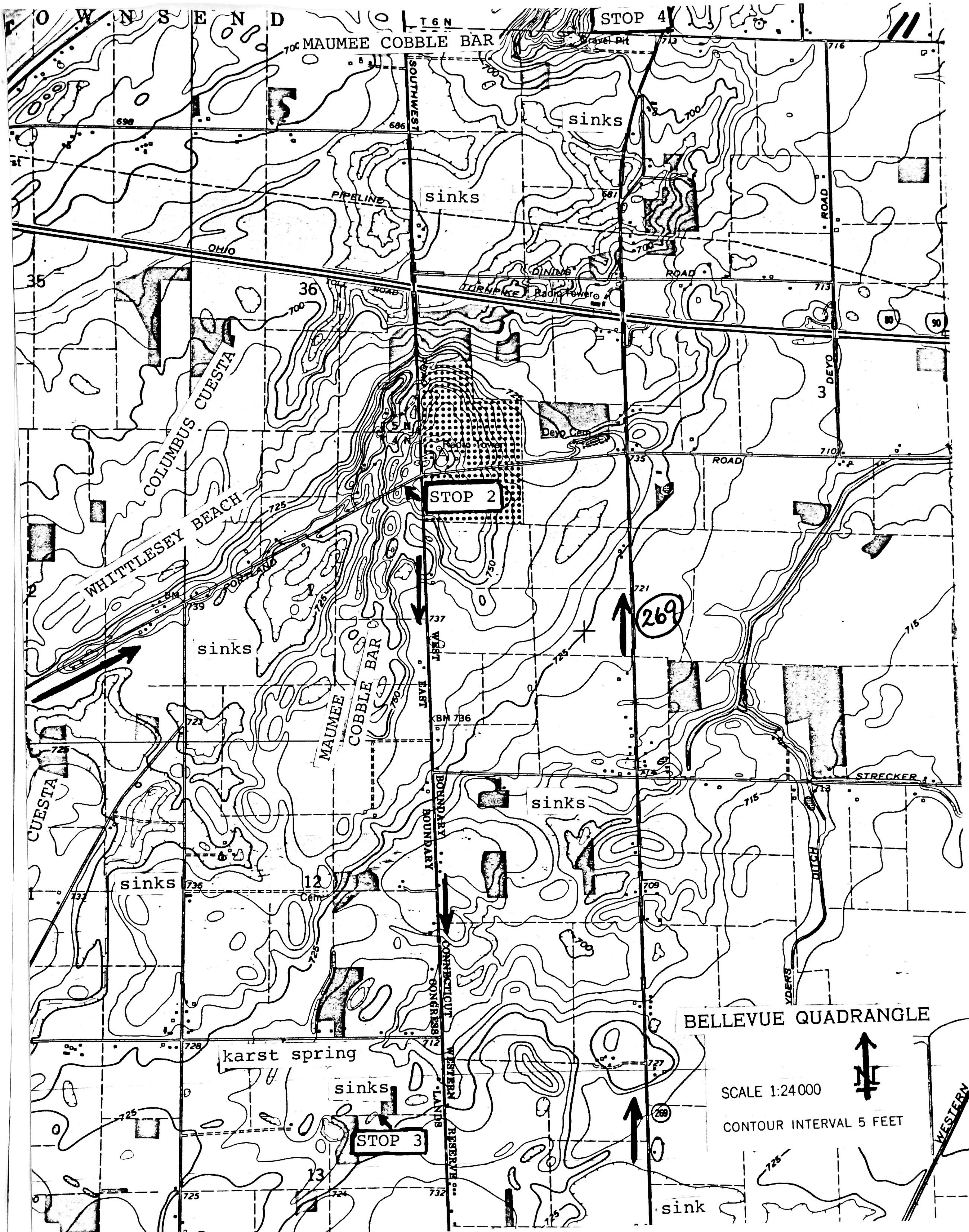
name	elevation	outlet
Modern Lake Erie	573'	Niagara River
Early Lake Erie (12,500 yr. B.P.)	423'	Niagara and other outlets to E
Lundy (Elkton)	615'	Cheboygan/Indian R. to L. Michigan
Lundy (Dana)	620'	
Lundy (Grassmere)	640'	
Warren III	675'	Grand R.[1]
Wayne	660'	Grand R.[1] ? or ?
Warren II	680'	Grand R.[1]
Warren I	690'	Grand R.[1]
Whittlesey (12,900 yr. B.P.)	735'	Ubly outlet to L. Saginaw and Grand R.
Arkona	710-690'	Grand R.[1]
Maumee III	780'	Imlay outlet to L. Saginaw and Grand R.
Maumee II	760'	outlet buried under later till on Michigan "thumb" leading to L. Saginaw and Grand R.
Maumee I (last date for glacier in Ohio: 14,300 yrs. B.P. for post-Wabash Moraine till in Williams County)	800'	via Fort Wayne to Wabash R.

[1] coextensive with L. Saginaw

Drawn from Burgis and Eschman, 1980; Calkin, 1970; Dorr and Eschman, 1970; Eschman, 1978; Forsyth, 1959; Goldthwait, 1958; Hough, 1958; and Leverett, 1902.

between-stop mileage	total mileage	
0.7	6.7	Turn L (N) off co. rd. 177 onto co. rd. 270. Route crosses dune-capped Maumee III beach, marked by old sand pits (both here and on to E from here)
0.4	7.1	Low rise with house on R is Maumee II beach (or offshore bar?), whose sand is visible in low road cut on L (W) and in fields. Low hills visible ahead after zigzag in road are Whittlesey-age dunes near route US 20, though they lie more than a mile south of the Whittlesey beach here.
1.1	8.2	Turn R (SE) off co. rd. 270 onto busy route US 20, cutting through high Whittlesey dunes ahead and on left.
1.3	9.5	Turn L (E) off US 20 onto co. rd. 288 just beyond (E of) York School on left, going through some Whittlesey dunes and then across till on the Maumee lake bottom.
1.7	11.2	Turn R (NE) off co. rd. 288 onto co. rd. 175. Co. rd. 175 follows the Whittlesey beach here, which has a strong (partly erosional?) beach slope to L (N). Note that land also lowers to R (S), behind beach, with local natural drains cut through beach; was this an offshore bar? (Interesting solar house to L, off beach, 1½ miles from turn onto Whittlesey beach.)
2.2	13.4	Depressions to south appear to be sinkhole-controlled; crest of Columbus cuesta is visible directly ahead.
1.4	14.8	STOP 2. Crest of Columbus Limestone cuesta. (5 mi. N of Bellevue; NE¼ sec. 1, T4N, R17E; York twp., Sandusky Co.). Whittlesey beach, route has been following, has probably changed to gravelly or cobbly content, here where it approaches Columbus Limestone cuesta, and then becomes an erosional shore as it bends northward along side of cuesta. Highest spot here, under tower to E, is 780' and must have been rocky shoal/island in Maumee III time; the high N-S rocky ridge (cuesta bedrock and/or cobble bar) at STOP 2 is at 750-770' and is probably also either a Maumee III shoal bar or Maumee II emergent bar, in

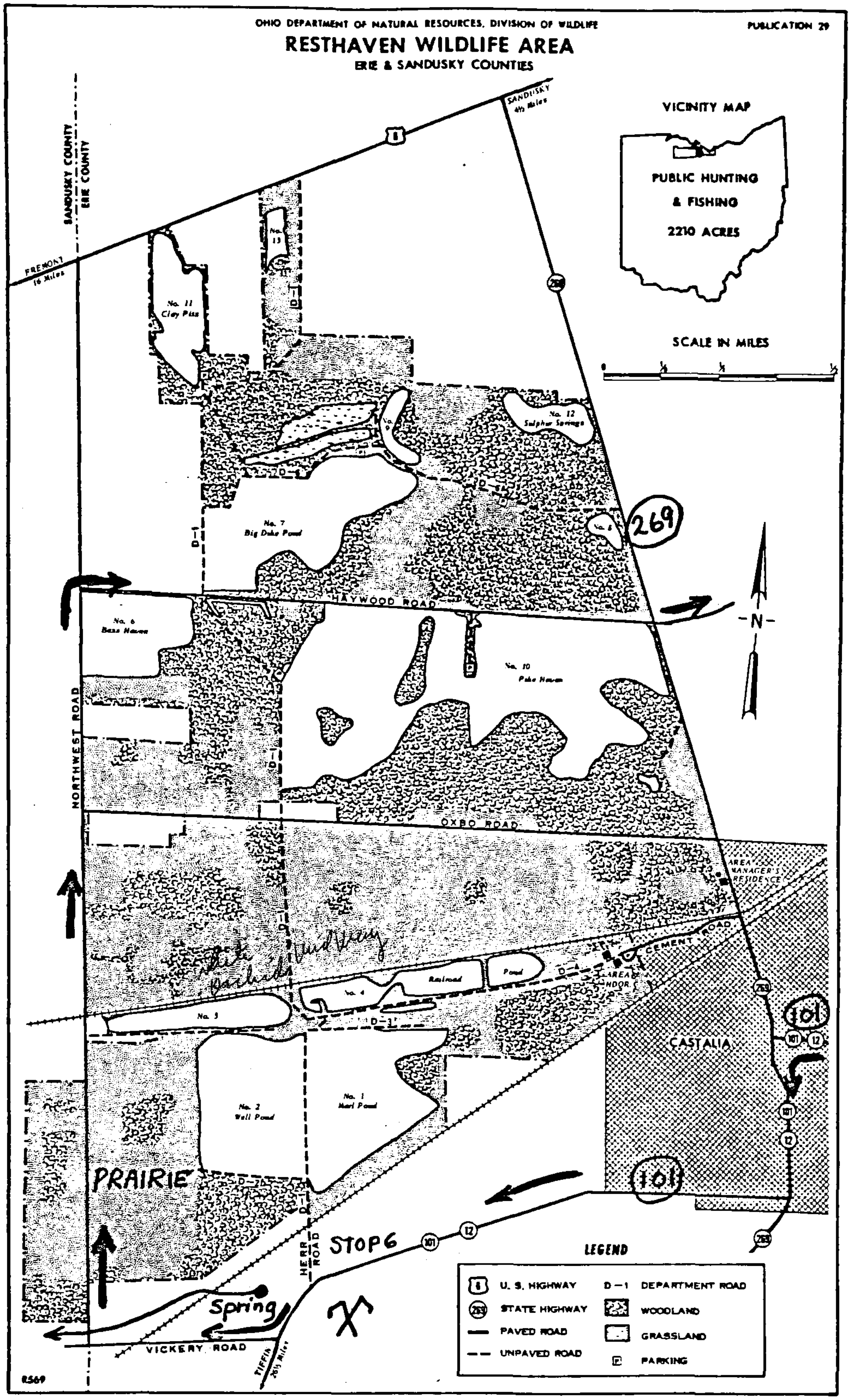
between-stop mileage	total mileage	
		either case probably composed of a thin deposit of rocky cobbles on Columbus limestone bedrock. (Nodding thistles (*Carduus nutans*), a beautiful, relatively uncommon thistle found mainly on carbonate bedrock or gravel/cobble deposits, flowers in unbelievable numbers here in early July - Studkey and Forsyth, 1971.)
0.1	14.9	Turn R (S) off co. rd. 175 onto Northwest Road (Sandusky/Erie county line road, so road names on two sides of road at intersections are mostly different).
		Route here lies on or close to crest of the Columbus cuesta. Ridge to R (W) is Maumee bar. Much of irregular topography and undrained depressions here represent karst topography. (See topographic map next page).
1.9	16.8	Wooded belt parallel to and just S of road to right hides (beneath woods and junk) a tiny karst stream that emerges at far (W) edge of woods and disappears at lower, nearer (E) edge of woods, but visibility of feature is restricted by brush and much discarded junk.
0.3	17.1	<u>STOP 3. Sinkholes in Columbus Limestone.</u> (2 mi. N of Bellevue; NE¼ sec. 13, T4N, R17E; York twp., Sandusky, Co.) Park as far off road as possible and walk back along fenceline to woods and several sinkholes exposing the limestone and solution-enlarged joints or swallowholes, discovered by Tintera in his 1980 thesis study. These sinkholes and the many others identified in this region demonstrate how Bellevue sewage, injected into this natural plumbing system by disposal wells through all those years, created and still creates, even with a new sewage-treatment plant, a serious groundwater-pollution problem.
		Continue on ahead (S).
0.7	17.8	Turn L (E) off Northwest Road onto Hale Road. Limestone bedrock is only 8' deep at this intersection.
0.6	18.4	Turn L (N) off Hale Road onto Ohio route 269. Limestone bedrock here east of the highest part


TOWNSEND
T6N
STOP 4
11
MAUMEE COBBLE BAR
Gravel Pit
sinks
sinks
PIPELINE
SOUTHWEST
OHIO
TURNPIKE
TOLL ROAD
Radio Tower
ROAD
DEYO ROAD
80
90
COLUMBUS CUESTA
Deyo Cem
Radio Tower
STOP 2
WHITTLESEY BEACH
PORTLAND ROAD
269
sinks
MAUMEE COBBLE BAR
WEST
EAST
BOUNDARY
BM 736
STRECKER
sinks
CUESTA
sinks
12
Cem
DITCH
SNYDERS
CONNECTICUT
CONGRESS
WESTERN RESERVE
LANDS
BELLEVUE QUADRANGLE
N
SCALE 1:24000
CONTOUR INTERVAL 5 FEET
karst spring
sinks
STOP 3
269
13
WESTERN
sink

between-stop mileage	total mileage	
		of the Columbus cuesta is only 5-10' deep, and route passes through a broad shallow sinkhole at bend in the road, a quarter of a mile north of the intersection. At next intersection (Strecker Road), rock is deeper (18-24'), but at following intersection (Portland Road), bedrock is only a few feet deep and is exposed along Ohio Turnpike just to the north.
4.4	22.8	Turn L (W) off route 269 onto dirt road leading to gravel pit. Would occupants of last car through please be sure that <u>gate is closed</u>.
0.3	23.1	STOP 4. Maumee III cobble island/bar. (3 mi. S of Castalia W of Ohio route 269; no sections here in these Connecticut - Western Reserve lands.) This coarse gravel deposit on the irregular crest of the Columbus cuesta is identical in composition with cobble beaches and bars adjacent to bedrock islands in modern Lake Erie, and is at 780', so it must also be a Maumee III bar. However the extent of land above 780' is very small, so this must have been a very tiny rock island offshore from a Maumee III Columbus-Limestone promontory. The northwest side of this feature is very straight and steep, and probably represents the erosional shore of Glacial Lake Whittlesey.
		Retrace route to route 269
0.3	23.4	Turn L (N) on route 269. Bedrock is only a few feet deep here, and the irregular land surface represents a complex karst landscape.
0.9	24.3	Turn R (E) off route 269 onto Parker Road. At this very high point on the Columbus Limestone cuesta, sinkholes are larger and deeper. Note large, deep sinkhole on L (N) just after turn. Note large low area to L (N) a mile from intersection; this sinkhole is 50' deep and over a mile long; we will make a brief stop in the other end of this sinkhole, where the road drops down into it.
1.3	25.6	Turn L (N) from Parker Road onto Billings Road.

between-stop mileage	total mileage	
1.0	26.6	**STOP 5.** Giant Castalia sinkhole. (1/2 mi. SE Castalia on Billings Road; area not sectioned here; Margaretta twp., Erie Co.) A quick stop to see the inside of one of Ohio's larger sinkholes -- only about 50' deep, but over a mile long, with fairly steep sides in places -- located almost on the crest of the Columbus Limestone cuesta. (Nodding thistle is abundant here, too.) Continue on ahead (N).
0.3	26.9	Turn L (NW) off Billings Road onto Bardwell Road; continue straight at red light. Route descends northwestward down off the Columbus cuesta to the lower level where the blue hole springs occur.
0.6	27.5	Stop sign, then keep left (NW) through center of Castalia. Lake to left is largest blue hole ("duck pond"), with emergence of water at far end of lake, as seen from this road. This is headwaters of Cold Creek (appropriately named), which flows north and then northeast to Lake Erie. Commercial Blue Hole, visited by 1957 OAS Geology field trip, lies half a mile to N (Coash, *et al.*, 1957).
0.2	27.7	Red light in center of Castalia. Turn L (S) and immediately turn L (E) again to park for lunch stop on grass beside lower end of "duck pond" blue hole (toilet available at Village Hall through back door, across street.) Continue on S across bridge over Duck Pond/Cold Creek, following route 101.
0.4	28.1	Stop, then turn right (W), following route 101. Route follows wave-eroded (and preglacially stream-eroded, too, undoubtedly) base of the Columbus escarpment. (Large abandoned quarry here is one we will come back to, and which is source of old vegetated tailings behind houses to left.)
1.5	29.6	Turn R (W) off route 101 onto Vickery Road. One of many smaller, but strongly flowing, springs is on right, the water emanating from the spring flowing northwestward and entering Sandusky Bay, and also crossed at our next turn.

between-stop mileage	total mileage	
0.5	30.1	Turn R. (N) off Vickery Road onto Northwest Road (the Erie/Sandusky County line road, and the west boundary of the Connecticut-Western Reserve lands). Road goes over drainage from small spring and then goes by the west edge of Resthaven Wildlife Area. The famous Resthaven prairie remnant lies on the right (E) for about a mile, beginning just beyond the trees near the spring drainage. Prairie species characteristically develop late in the year and bloom in August/September, so this field will look very unimpressive in April, but this is one of the most famous of the prairie remnants in the famous prairie peninsula in Ohio, and has been studied both floristically and managerially in some detail. Beyond the prairie, the typical Resthaven landscape of wet marl diggings, small open ponds, and scrubby, brushy vegetation is visible, showing the efforts of nature (and now ODNR) to readorn an ugly mined-out landscape where thick, extensive, natural marl spring-deposits once occurred.
2.2	32.3	Turn R (E) off Northwest Road onto Heywood Road (dirt), where better views of Resthaven landscape can be seen.
1.6	33.9	Stop at route 269, then continue ahead (E) on Heywood Road over thinner, unmined marl deposits, on a landscape probably much like Resthaven was like before 1900.
0.5	34.4	Turn R (E) off Heywood Road onto Homegardner Road, crossing Cold Creek, the drainage from the Duck Pond blue hole, and continuing over flat lacustrine silts and clays.
0.8	35.2	Turn R (S) off Homegardner Road onto Maple Avenue. Flat lacustrine silts and clays are also present here, overlain by sand farther south, next to the rise onto the cuesta. Driving south on this road provides a view of the Columbus Limestone cuesta at the point near Castalia where it lowers in height, due to the past river (and wave) erosion, and offsets to the northeast. This limestone is visible again to the north in quarries: four miles away near Sandusky, 10 miles away on Marblehead peninsula (in one of the biggest quarries in the state), and 17 miles away on Kelleys Island (large abandoned quarries) (plus quarries on Pelee Island and near Pelee Point, in Canada).


OHIO DEPARTMENT OF NATURAL RESOURCES, DIVISION OF WILDLIFE
PUBLICATION 29
RESTHAVEN WILDLIFE AREA
ERIE & SANDUSKY COUNTIES
VICINITY MAP
PUBLIC HUNTING
& FISHING
2210 ACRES
SCALE IN MILES
SANDUSKY COUNTY
ERIE COUNTY
FREMONT 16 Miles
SANDUSKY 4½ Miles
No. 11 Clay Pits
No. 12 Sulphur Swamp
No. 7 Big Duke Pond
No. 6 Bass Haven
No. 10 Pike Haven
HAYWOOD ROAD
OXBO ROAD
NORTHWEST ROAD
CEMENT ROAD
AREA MANAGER'S RESIDENCE
CASTALIA
Railroad
Pond
No. 4
No. 5
No. 2 Well Pond
No. 1 Marl Pond
HERB ROAD
VICKERY ROAD
TIFFIN
269
101
PRAIRIE
STOP 6
Spring
LEGEND
U. S. HIGHWAY
STATE HIGHWAY
PAVED ROAD
UNPAVED ROAD
D—1 DEPARTMENT ROAD
WOODLAND
GRASSLAND
PARKING
-N-

between-stop mileage	total mileage	
1.3	36.5	Turn R (W) off Maple Avenue onto Ohio route 101 and rise up onto the lowering north end of the cuesta, here just east of Castalia.
1.0	37.5	"Duck Pond" blue hole on left (this is same point as mileage 27.5).
0.2	37.7	Red light in Castalia. Turn L (S) following route 101. south to stop sign and then west again to Wagner quarry.
1.3	39.0	STOP 6. Wagner Castalia Quarry in Columbus cuesta.

STOP 6. Wagner Castalia Quarry in Columbus cuesta.
(by special permission)
(1 1/2 mi. W of Castalia; not sectioned here; Margaretta twp., Erie Co.). Pull off into large dirt parking lot to R (N) and park, and walk into quarry on opposite side of road (those wishing to leave early should be sure their exit is not blocked).

This quarry, belonging to the Wagner Quarries Company of Sandusky, is the only large quarry exposing the Columbus Limestone in the cuesta here. The Columbus Limestone makes up approximately the upper half of the exposed section, with the Detroit River dolomites, also of Middle Devonian age, occupying the lower half. The Detroit River Group is divided into two members, here on the east side of the Cincinnati Arch crest, the (upper) Lucas Dolomite and the underlying Amherstburg Dolomite, but the lithologies of these two units are very similar and fossils are scarce, so distinction of these two units and their contacts is very difficult. In addition, some authorities describe the Columbus as being made up of two members, an upper limy, very fossiliferous unit and a lower dolomite, poorly fossiliferous unit, confusing still more the problem of recognizing the contacts of the Detroit River dolomite members.

According to Stout (1941, p. 360), the section present in this quarry is:

Columbus Limestone - 42' of thin to medium-bedded, very fossiliferous limestone over a basal, flinty, massive gray dolomitic zone

Lucas Dolomite - 12' of hard, brown, fine-textured, poorly fossiliferous dolomite

Amherstburg Dolomite - 18' of massive, hard, finely crystalline dolomite, with a few fossils

In contrast, Carman (1927, p. 501-2) identifies 50' of Columbus Limestone, over the Detroit River, with an unclear contact between the Lucas and Amherstburg, though he identifies the presence of 30' of Lucas over 20' of Amherstburg, the latter containing some fossils, "such as Proetus crassimarginatus, Schuchertella amherstburgensis, Spirifer sulcatus" etc.

Charles Kahle reports that he found identification of the actual contacts here extremely difficult and unsure. "There seems to be no question by any of these sources that at least two, and possibly three formations are here. All of these sources are mature, highly competent geologists, and yet they disagree concerning the actual locations of the contacts, the nature of the Columbus section, and whether or not the Amherstburg Dolomite is present. Thus the section illustrates the problems presented by the Devonian stratigraphy of this area. However, this is your chance to look at the section carefully and decide for yourself what formations are here and where you would put the formational boundaries."

The only detailed measured section taken in the quarry is that by Janssens (1970), though he does not distinguish the two subdivisions of the Detroit River. His measured section is included here, almost verbatim, on the following pages.

This is the last stop of the trip, so participants can take as long as they wish here. Access to the upper levels, where the Columbus Limestone can be observed, together with striking solution features and beach cobbles, is by a road to the right.

NOTE: Although this is an old, abandoned quarry, the walls are steep. THIS IS A VERY DANGEROUS PLACE! BE EXTREMELY CAREFUL IN THE QUARRY, MAKING SURE THAT YOU NEITHER KNOCK ROCKS DOWN ON THOSE BELOW YOU NOR BE UNDER A WALL FROM WHICH ROCK MIGHT FALL.

We hope that you have enjoyed the trip, and look forward to seeing you again next year.

Castalia Quarry Section
(after Janssens, 1970, p. 14-16)

Unit	Feet	Inches	
COLUMBUS LIMESTONE			
22	30	0	Limestone, very light-brown fine- to coarse-grained, fossiliferous to biostromal (brachiopods, corals, crinoids); breaking into beds 18 inches thick or less; some nodular light-brown and gray chert in lower half; dolomitic near the base; pot-holes present at top in south end of quarry
21	12	0	Dolomite, medium-brown, medium-grained, fossiliferous (brachiopods, corals, stromatoporoids), porous (fossil vugs), massive, styloltic; with sparry dolomite (fossil replacement); laminated in basal foot
20	2	8	Dolomite, medium-brown, fine-grained, slightly sandy (fine-grained sand), sparsely fossiliferous (brachiopods); some sparry dolomite
DETROIT RIVER			
19	0	9	Sandstone, light-gray- and medium-grained, dolomitic; grading upward into sandy dolomite; styloltic upper contact
18	2	7	Dolomite, light-brown, fine-grained, sandy to very sandy (fine-grained sand); few clasts of dense light-gray dolomite; mottled medium gray (burrowed) in top 6 inches; styloltic upper contact
17	1	4	Dolomite, light-brown, fine- and medium-grained; weathering very light gray; few solitary corals

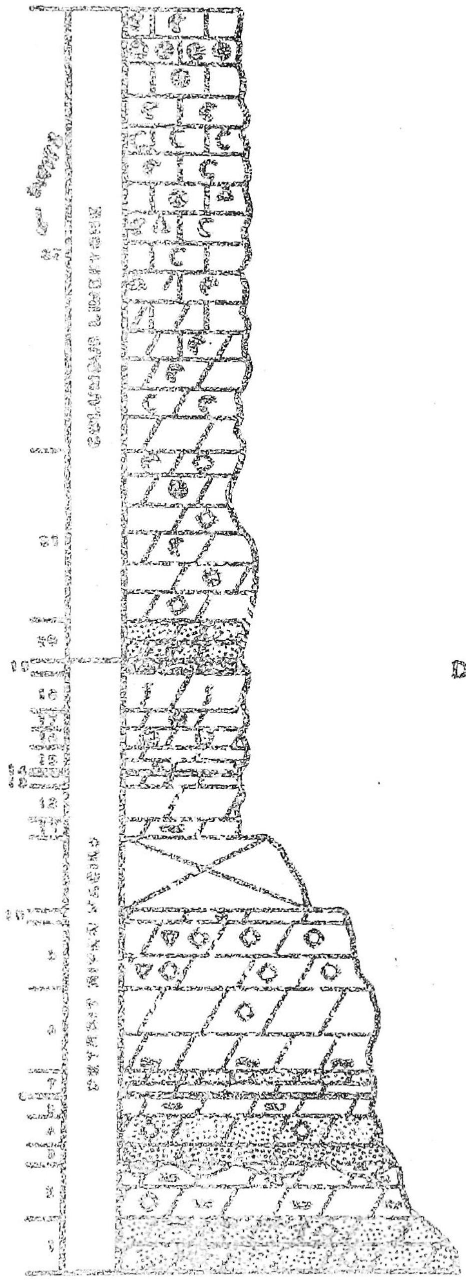


FIGURE 6.-Section at Castalia quarry.

16	1	7	Dolomite, medium-brown, fine- and medium-grained; mottled (burrowed); fossiliferous to biostromal (stromatoporoids, few corals); dark gray locally at base; weathering light gray in lower half
15	1	5	Limestone, medium-brown, fine-grained; grading into dolomite; laminated in top 6 inches; black carbonaceous fragments and brown sparry calcite or dolomite in basal ½ inch
14/13/12/11	3	11	Dolomite, medium-gray to brown, dense, sandy, burrowed; purple laminations; weathering very light gray and purplish
	5	0	Covered interval
10	0	11	Dolomite, light-brown, dense; mottled purplish; weathering very light gray; some sparry dolomite
9	4	9	Dolomite, light-brown, fine- to coarse-grained, very fossiliferous (gastropods), very porous; much sparry dolomite in lower half; grading into unit above; upper contact stylolitic
8	5	4	Dolomite, light-brown, fine-grained; very finely laminated in basal foot; some sparry dolomite and rust-colored laminations
7	2	2	Dolomite, medium-brown, dense to medium-grained, burrowed; light pinkish brown upward; sandy in upper half; laminated in middle; stylolitic upper contact
6	0	1	Dolomite, light-brown; probably dolomitized sparry biocalcarenite; sharp upper boundary

5	0	11	Dolomite, medium-brown, dense; sharp upper boundary
4	2	0	Dolomite, light- to dark-brown, fine-grained; sandy at base; much sparry white dolomite; top 3 inches very finely laminated; sharp upper boundary
3	1	3	Sandstone, light-gray, fine- and medium-grained, dolomitic, burrowed; gradational upper boundary; sand grains rounded and frosted
2	3	8	Dolomite, very light- to medium-brown, fine-grained; very finely laminated in large part; breaking in beds 6 inches thick or less; upper boundary sharp and undulatory (ripple marked); low areas on ripple-marked surface filled with up to 3 inches of dolomite with black carbonaceous laminae
1	3	6	Dolomite, medium-brown, fine-grained, slightly sandy, slightly fossiliferous (solitary corals), massive; fair intergranular porosity; patches of sparry dolomite; laminated in top foot

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